

It must be acknowledged that since the conclusion of the war there has been a remarkable development in public opinion as to the importance and value of education. The demand for secondary education has increased enormously, and the claims for admission to technical colleges and universities have been almost too great for their resources in teaching staff and equipment. In the year 1913-14 the number of full-time university students in the British Isles was roughly 30,000, or about 6.5 per 10,000 of population. The figures available for the year 1918-19 show that the number of students had almost reached 40,000. The number of students per 10,000 of population had jumped to 8.6; almost one in every thousand was receiving university training.

There has been but slight consideration given in the Report of the Select Committee to the enormous rise in the cost of materials and equipment, especially in reference to the secondary schools and technical institutions, during and since the war, nor has sufficient weight been given to the necessary rise in the salaries of the teaching staff due to the increased cost of living. This item alone accounts for 21,000,000*l.* in the estimated expenditure. If the schools and the higher institutions of learning are to be staffed efficiently with well educated and trained men and women, adequate salaries and prospects, and an assured provision such as the Teachers (Superannuation) Act affords for the time when they are no longer capable of rendering effective service, must be offered.

Mr. Fisher in a recent interview shows conclusively with regard to the Report in question that there are adequate safeguards in respect of extravagant expenditure both on the part of the Board of Education and on that of the public represented by the ratepayer. The nation will be well advised to encourage by all the means in its power the desire which is so plainly manifest for a longer life in the schools and for the advantages of an efficient secondary and university education for those who are qualified to receive it. Now that the war is over we are entering upon a serious and strenuous time, when all the trained brain power at our command will be needed to meet the competition which we shall assuredly be called upon to face, and after all, as Mr. Fisher truly said in the interview before alluded to, "a nation which can afford to spend 400 millions a year upon drink and 100 millions upon tobacco is not quite at the end of its resources."

NO. 2671, VOL. 106]

Territory and Bird Behaviour.

Territory in Bird Life. By H. Eliot Howard. Pp. xiii+308. (London: John Murray, 1920.) Price 21*s.* net.

ON the publication of his "British Warblers" (1907-14) Mr. H. Eliot Howard took rank as a naturalist of marked ability, as an observer who could be trusted, and as an interpreter well trained in scientific method, fertile in suggestion, cautious in application, and, above all, insistent on the importance of keeping in close touch with the evidence afforded by patient and systematic field-work. A salient outcome of his monograph was a re-grouping of the phenomena presented by birds in their breeding haunts around a concept of "territory." He has now marshalled the evidence in favour of this hypothesis in a work which neither the biologist nor the comparative psychologist can afford to neglect.

To grasp Mr. Howard's root idea, we must recall the familiar routine of a bird's behaviour—and it is clearly with behaviour that observation must primarily deal. There is an orderly sequence the biological value or utility of which is centred in race-maintenance. Within this we can readily distinguish successive phases which are contributory to the routine as a whole. In the life of the wide-range migrant there is departure from the south, arrival in England, settling down in some part of the country, mating, sexual union, nest-building, incubation, feeding and rearing of offspring, and then departure from the breeding quarters to the south. All this is familiar enough. But closer observation discloses other facts. The males arrive in advance of the females; each male settles down in a restricted area within which some bush or tree is thenceforth his headquarters; the extent of this area is determined by the range of flight in oft-repeated excursions from the headquarters, and constitutes the "territory," which varies in size according to the species; the male bird is intolerant of any intruder into this territory, especially of a male of his species, fights him, and drives him out; he sings with maximum vigour at headquarters before any female is in evidence; this expression in song makes an attractive impression on some hen bird when she arrives in migration from the south; she becomes his mate, lives with him within the territory, and helps to drive out intruders. Mating is consummated, a nest built, and a brood reared within the territory, which affords, in the main, sustenance to the family; and in due season they depart. Now, of course, the sexual act may be regarded as the pivot on which the whole system of behaviour turns. But Mr. Howard contends that, to change

the metaphor, the territory is the scene of the drama between arrival and departure; that the territory is secured and defended and the outburst of song in evidence before the females arrive; and that the size of the territory is such as to meet the requirements of the future. He holds, then, that the territory, if not the pivot in which the cycle of behaviour is centred, is the hook of biological utility on which it is hung.

Now, with regard to any routine of behaviour or phase therein, four questions arise: (1) In respect of the behaviour itself, is it unlearned, or is it acquired in the course of individual experience? (2) Under what conditions of external stimulation does it come? (3) What is the good of it—its biological value? and (4) On what, in the constitution of the bird, does it depend? To the first three questions observational evidence affords the data for a reply. The answer to the last is in large measure a matter of inference.

As to the first, Mr. Howard is quite clear that, on the evidence, much of the behaviour involved in territorial routine is in form unlearned. In so far as it is unlearned, it is instinctive. This does not mean that the constituent details, as the matter incorporated in the behaviour as a whole, are purely instinctive. They are obviously in large measure learnt. Skill in their performance has been acquired. It means that the male bird in his first year occupies and protects the territory, and acts therein in specific ways, without having learnt by previous experience this *form* of behaviour-routine as a whole. Secondly, the external stimulation is, in Mr. Howard's opinion, afforded by the territorial situation, and not, in the early stage, by the presence of a female. To drive away an intruder involves, of course, the stimulus of his presence; it is, however, within the territory that the occupant attacks him; elsewhere, beyond its confines, the behaviour is no longer the same. The territory is, therefore, a feature of the situation that counts. Thirdly, it is clear enough, on the evidence, that the procedure has biological value. But—and this is of prime importance—Mr. Howard does not regard the prospective value of instinctive behaviour as implying the presence in mind of an end for the sake of which the bird acts. The biological value of securing a territory is the mating which follows in due course. *We* expect this outcome because we have knowledge of routine based on observation. But if the male in his first year has never mated, he cannot, on the basis of individually won experience, foresee this mating and what follows thereon. It is

not for him an end to be attained by his behaviour. This is important—nay, essential—to the interpretation offered. For if there be inherited *knowledge*, the whole matter is easily explained as due to ancestral experience transmitted through "memory" to the bird that behaves under its guidance.

We come, then, to the fourth question: On what, in the constitution of the bird, does the behaviour depend? Mr. Howard refers to physiological changes in the organism which are correlated with tendencies to act in just that way which is open to observation in the unlearned behaviour. This is what we speak of in a broad and general way as the nature of the bird. But this nature, and the correlated psychical nature, is different on different occasions. It is also attuned to the circumstances at the time, and gives to the behaviour much of its biological value. Such an attunement of the nature Mr. Howard calls a disposition. It is a state of physiological and psychical preparedness to act appropriately when the requisite stimulation is afforded. At the moment of action it is focussed as impulse. Thus at least may be interpreted many of Mr. Howard's statements, though in others there seems to be little difference between disposition and impulse. He often speaks of the disposition or the impulse as being "rendered susceptible to stimulation." For example, the territorial situation renders the impulse to drive away intruders susceptible. Some might prefer to speak of the susceptibility of *the bird* when it is in such a state as to respond to these or those external conditions. We thus avoid the risk of hypostatizing a disposition or "an instinct." The essential point, however, is that the disposition that is inferred from the performance of unlearned acts has factors which are congenital, and do not depend on individually won experience.

Brief illustration may here be given of changes of disposition. During the winter, before the mating season, lapwings live together in flocks. The males are seemingly on the most friendly terms with each other. Just such minor squabbles occur as may give some savour to the life of enjoyment. The females are, for the males, just other birds in the flock, and are not viewed, so to speak, in the light of a disposition to mate. Then in due season come the changes which constitute *ad hoc* physiological and psychical preparedness. Now one male and now another leaves the flock and occupies a territory in the fields; and, once there, he is intolerant of other

males, fighting with any intruder for all he is worth. With the physiological change (partly due to specific internal secretions contributed to the blood-stream) there is a complete psychical change in the dispositional attunement of the bird's nature. Substantially the same presentation afforded by another male is now linked with quite different modes of overt behaviour. No longer gregarious, he is a solitary occupant of a restricted domain, driving all other males away. Presently he is joined by a mate, and the normal routine of reproduction runs its course. But if a cold snap should come on, the separated males may reunite in a flock, and the male is then no longer intolerant of other males. The physiological state probably reverts to its winter poise, and with this is correlated a reversion to the previous psychical disposition. But it seems that when a male bird (lapwing or other) has secured a territory and is intolerant therein of all others save a mate, he sometimes returns for a while to the flock which occupies a neutral area. There he is no longer intolerant of others, but moves among them on quite friendly terms. Hence in different circumstances, (1) in his territory and (2) in the flock, his disposition is different, so that occupancy of a territory appears to be a determining condition of the behaviour observed therein. If this sort of thing occurred in so marked a form in human life, it would perhaps be attributed to "dissociation," and described as an instance of double personality, two "streams of consciousness" being separated as if by a barrier. In any case, just thus, it seems, does the male bird in his first year behave, though he has never so behaved before, or seen others so behave.

Exigencies of space preclude more than an outline sketch of Mr. Howard's main thesis. The treatment in detail is admirable in its method of raising and meeting difficulties with no attempt to shirk them. The way in which the expression of song may produce a different impression on others at different times and in different circumstances is dealt with suggestively. All may not agree with Mr. Howard's conclusions; but all will admit the transparent candour of a genuine seeker after truth. One would like to comment on his contribution to the solution of the difficult problem of migration—turning upon the alternating interplay between the territorial and the gregarious poise in disposition. But lack of space forbids. The book is well written, well printed, and well illustrated, with photogravures from drawings by Mr. G. E. Lodge and Mr. H. Grönwold.

C. LL. M.

Airscrews in Design and Performance

Airscrews in Theory and Experiment. By A. Fage. Pp. ix + 198 + 7 folding plates. (London: Constable and Co., Ltd., 1920.) Price 34s.

IT is difficult to place this book in the scheme of aeronautical progress, for it does not deal adequately with either the theory or the practice of airscrew design. The author has not succeeded in the idea expressed in the first sentence of his preface, where he says that "an endeavour has been made to present in this work an accurate and comprehensive account of the science of the airscrew from both its theoretical and experimental aspects." It is well known to all those connected with the experimental side of aeronautics that Mr. Fage, as a result of his position at the National Physical Laboratory, has had greater facilities for original work than any other British worker. The number of papers in his name which occur in the bibliography testifies to his activities, and the book cannot fail to have an importance in many directions. One would select chaps. v., vi., and vii.—that is, those dealing with experimental data—as justifying the writing of this book.

What is missed is the presentation of the results of research in a form which stimulates application to the workaday theories of the immediate future. Instead, one finds a very important recent development of theory compressed into one and a half pages of the book in such a way that, without prior knowledge, it conveys nothing to the reader. The basic theorem on which design rests comes from the conception that the several elements of an airscrew blade produce an airflow which is essentially of the same character as the flow round a wing. The application of this theory to aerial propellers is due to Drzewiecki and Lanchester, but after some little use and comparison with experiment it was found to be insufficiently accurate for design purposes. The necessary idea for a next approximation was obtained from a realisation of the fact that a wing is always moving into fresh air, whilst an airscrew blade moves into air disturbed by other blades and by the previous passages of the blade itself. The thrust of an airscrew, being produced by dynamic means, involves the throwing back of a mass of air per second the axial momentum of which is equal to the thrust. Owing to the continuity of the airflow, it might therefore be expected that disturbances due to other blade passages would take the form of an "inflow" of air into the airscrew blade. Experiment provides support for, and can be used to give quantitative values to, a theory based on this idea.

In discussions of marine propellers, Froude